

Quasi-Crystalline Undercooled Alloys for Space Investigation (QUASI)



U.S. PI: Dr. Kenneth Kelton, Washington University DLR Team Coordinator: Dr. D. Holland-Moritz, IFR, Germany

NASA Objectives and Contributions:

- Determine the influence of liquid and solid short-range order on the nucleation barrier
- Determination the composition dependence of nucleation rate and evaluate a new coupled flux model for nucleation
- Correlate the nucleation kinetics with the local structure of the liquids
- Correlate the local structure with containerless measurements of thermophysical properties
- Determine changes in the growth rate of the solid as a function of the complexity of the solid phase

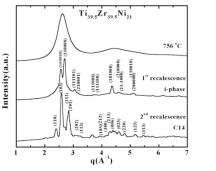
Relevance/Impact:

- Quasicrystals have unique structures holding promise for exciting new alloys.
 The open structure enables the storage of and controllable release of hydrogen.
- Other potential applications include IR detectors, batteries, and high temperature corrosion resistant coatings

Development Approach:

- Thermophysical properties of quasi- and polyhedral- phase forming alloys will be measured in the undercooled state, and their transformation to crystalline solids observed.
- Sensitivity to impurities from containers will be avoided by the use of levitators – in ground-based studies with an electrostatic levitator and on ISS with a German electromagnetic levitator.
- Many thermophysical properties can be measured in a levitator on Earth, but with convective contamination. This contamination plays a significant role in the formation of the intermediate phases. In particular nucleation and viscosity measurements demand quiescent conditions.

Marshall Space Flight Center Ground-based Research Electrostatic Levitator



undercooled

i-phase, 1 sec exposure exists for 3-4 s only

C-14 Laves phase

Diffraction patterns taken in levitated undercooled sample within the Argonne synchrotron (BESL). Shows metastable i-phase nucleated from the undercooled liquid

ISS Resource Requirements

100 Resource Requirements								
Accommodation (carrier)	Electromagnetic Levitator (EML) in Columbus Orbiting Facility							
Upmass (kg) (w/o packing factor)	0.01 for samples							
Volume (m³) (w/o packing factor)	10e-8							
Power (kw) (peak)	TBD							
Crew Time (hrs) (installation/operations)	2							
Autonomous Operation	TBD							
Launch/Increment	TBD							

Project Life Cycle Schedule

Milestones	SCR	RDR	PDR	CDR	VRR	Safety	FHA	Launch	Ops	Return	Final Report
Actual/ Baseline	11/02							2012			